PAINTING PROCESS IMPROVEMENT FOR AUTOMOTIVE INDUSTRY

MUHAMMAD FARID BIN M FATHIL

A report is submitted in partial fulfillment
of the requirements for the award of the degree of
Bachelor of Mechanical Engineering with Automotive Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2008

SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Automotive

Signature

Name of Supervisor : Dr Kumaran Kadirgama
Position : Lecturer
Date : 10th November 2008

Signature
Name of Panel : Mohd Rashidi Maarof
Position : Lecturer
Date : 10th November 20008

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature

Name : MUHAMMAD FARID BIN M FATHIL

ID Number : MH05032

Date : 7th November 2008

ACKNOWLEDGEMENTS

Alhamdulillah. First of all, I would like to express my grateful to ALLAH S.W.T for the successful finish this project. I also want to thank to my supervisor, Ir. Hj Nik Mohd Zuki b Nik Mohamad for his germinal ideas, invaluable guidance, continuous encouragement and constant support in making this project possible.

I also would like to thank to Mr. Tarmizi Mat Ariff, Maneger of Paint Shop, for giving the permission to do my case study at AMM Sdn. Bhd. Also, not forget, Mr Amin Azman, Foreman of Paint Shop, for his cooperate and information that I needed, and lastly the workers at Paint shop. May Allah Bless them.

Not forgetting to my friends for helping me to grow further and influence my project in order to finish this project. I appreciate very much to them because of the idea and information given along done this project.

I acknowledge my sincere indebtedness and gratitude to my parents for their love, dream and sacrifice throughout my life. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to attain my goals. Special thanks should be given to my committee members. I would like to acknowledge their comments and suggestions, which was crucial for the successful completion of this study.

Dedication;

To My late father, M Fathil B Che Mahmood,

My mother, Nur Aisyah Bt Jusoh, and

All My beloved persons

ABSTRACT

Painting process is an important process in automotive industry. The purposes of the process are to give more attractive appearance to the vehicles and to provide the layer of protection against corrosion and weathering. The painting process are include a few other process, which are Pre-Treatment and Electrodeposition (ED) Process, ED sanding, process, sealant and PVC process, primer process, and top coat process. The objective of the project are to identify the problems occur in ED sanding process and reduce the problems to improve the ED sanding. The study was done at AMM plant in Pekan, Pahang. The methods used to identify the problems are based on the four M method, which are Manpower, Machine, Method, and Materials. The study implement total quality management tools to analysis the problems. From the study that have done, the major problems are the foreign material and the scratch. The foreign material can be reduced by making the solvent so that the layer of anti-corrosion can be eliminate. Meanwhile, the scratch is cause by manpower. The lesss the worker touch the vehicle body, the less scratch formed on the vehicle surface body.

ABSTRAK

Proses mengecat merupakan suatu process yang penting dalam industi automotif. Proses ini bertujuan untuk memberi penampilan yang menarik kepada kereta dan menyediakan lapisan perlindungan melawan cuaca dan karat atau hakisan. Proses mengecat terdiri daripada beberapa proses yang lain, iaitu proses pra-rawatan dan Elektrodeposisi (ED), proses ED *sanding*, proses *sealant* dan *PVC*, proses primer, dan proses *Top Coat* . Objektif projek ini adalah untuk mengenalpasti masalah yang berlaku di dalam *Ed sanding* dan mengurangkan masalah yang berlaku untuk menambahbaikan *ED sanding* . Kajian dilakukan di kilang Automotive Manufacturer Malaysia (AMM) Sdn. Bhd. di Pekan, Pahang. Keadah yang dilakukan untuk mengenalpasti masalah yng berlaku adalah berdasarkan kepada empat M, iaitu *Menpower* (tenaga kerja), *Machines* (mesin atau peralatan), *Methods* (keadah-kaedah) dan *Materials* (bahan-bahan). Analisis yang digunakan di dalam kajian ini adalah dengan menggunakan Alat-Alat Pengurusan Kualiti Keseluruhan (*Total Quality Management Tools)*. Daripada kajian yang dibuat, masalah-masalah yang paling besar adalah bendasing dan calar pada permukaan badan kereta. Bendasing boleh dikurangkan dengan membuat pelarut supaya lapisan anti-karat dapat dihapuskan. Manakala, calar disebabkan oleh tenaga kerja. Semakin sedikit pekerja menyentuh badan kereta, semakin kurang calar terbentuk di permukaaan badan kereta.

TABLE OF CONTENTS

CHAPTER 2 LITERATURE REVIEW

CHAPTER 3 METHODOLOGY

CHAPTER 4 RESULTS AND DISCUSSION

CHAPTER 5 CONCLUSION AND RECOMENDATION

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOL

%	Percentage
^{o}F	Degree of Fahrenheit
^{o}C	Degree of Celsius

LIST OF ABBREVIATION

4M	Manpower, machine, method and material
AMM	Automotive Manufacturer Malaysia
BIW	Body-in-White
DC	Direct Current
ED	Electrodepositon
HBR	High Bake Repair
JIT	Just-in-Time
LBR	Low Bake Repair
OEM	Original Equipment Manufacturer
PVC	Poly-vinyl Chloride
TQM	Total Quality Management
UV	Ultra-violet

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

The automotive industry involved in the manufacture of motor vehicles, including most components, such as engines and bodies, but excluding tires, batteries, and fuel. The industry's principal products are passenger automobiles and light trucks, including pickups, vans, and sport utility vehicles. This industry involved in design, manufacture, and marketing of the vehicle. There are several processes in automotive industry in manufacturing a vehicle. The processes in manufacturing a vehicle are stamping process, body assembly process, painting process, and trims and final processes.

One of the major cost factors in car manufacturing is the painting of body and other parts such as wing or bonnet. Surprisingly, the painting may be even more expensive than the body itself. Maybe the high costs are in terms of processes that occur in painting process and not the machines that applied in paint shop. From this point of view it is clear that car manufacturers need to observe the painting process carefully to avoid any deviations from the desired result. Reduced paint use and reduced defects would save $683 million annually for the Big 3 manufacturers and would lower costs and improve quality for consumers.

With these time costs, manufacturers could only afford sampled quality control, measuring approximately 1 to 3 cars per day, or about 1 out of every 500 vehicles. Moreover, the slowness of the quality control contributed to poor feedback response time. By the time quality control detected a problem and made proper adjustments, up to 100 vehicles had passed through the defective painting production line. Manufacturers had to repair all vehicles with defective paint coatings by using one or both of the low bake repair (LBR) and high bake repair (HBR) processes, at a cost of $600 to $1,200 per vehicle in 1995. In some extreme cases, the manufacturer had to completely scrap the vehicle.

Car painting is a complex combination of different layers of base coat, color and protective finishing coat. The setup for the painting process requires the optimal adjustment of a variety of different parameters such as humidity, temperature and the consistence of the lacquer itself.

1.2 PROBLEM STATEMENT

There are impossible to achieve zero defects in the whole painting processes. The problems come from the 4M, which are men, machines, methods and materials. Therefore, to improve the process is by reducing the defects or problems as lower as possible. The tasks are to study the method that use in the process and propose a new method that can overcome the defects or problems.

1.3 THE PROJECT AIM AND OBJECTIVES

The aim of this project is to reduce the problems that occur at painting processes. In order to achieve the aim, the following objectives are required

- To identify the defects that occurs in painting processes
- To improve the painting process in the automotive industry

1.4 SCOPES

The study is held at Automotive Manufacturer (Malaysia) AMM Sdn. Bhd., Pekan, Pahang. The model vehicle involve are two models, which are Naza Forza and Suzuki Swift. The detail studies are on ED sanding process in painting process.

CHAPTER 2

LITERATURE REVIEW

2.1 HISTORY OF AUTOMOTIVE PAINTING

Ever since the first automobiles were made in the late 1800's, there have been many changes in paint technologies to protect and beautify these manmade transportation devices, from natural products to high tech polymers. In the first part of the 20th century automotive paint technology was based on the same air-dry varnish systems that were used for wooden furniture and horse drawn carriages. The major drawback was that the only choice of color offered was black. In addition, they required tedious brush application of multiple coats and days of drying time, which created a production bottleneck.

The history of paint protectants goes back to the days of horse drawn carriages also. The coatings were mainly protected by applying animal fats. Later, waxes and oils were used. The fats and oils helped seal the coatings from moisture and kept the wood frame from drying out. They also helped increase the gloss and the beauty of the finish. These materials had to be applied frequently to maintain their protective properties. This method of protecting and beautifying the finish was carried over to automobiles, which replaced carriages. The early automobiles also had a wood frame and had very similar coatings as well.

Being a ferrous metal, steel must be coated to prevent corrosion and although some body parts were later galvanised, paint was the obvious solution because it is both protective and decorative [5].

The lack of coatings that were easy to apply, more durable, and fast drying, became obvious handicaps to the efficient production of the motorcar. As advances in chemistry were discovered in the laboratory, advances in coatings technology were close behind. In 1923, E.I. DuPont De Nemours developed nitrocellulose lacquer systems, which offered many color choices and easier application using spray guns. However, lacquer systems required spray application of 3-4 coats of paint to achieve the desired properties. Lacquers also by their very nature have poor resistance to certain chemical solvents.

Nitrocellulose paints ushered in the practice of spray application and their drying time was significantly shorter. Another benefit to this advancement was that a larger number of colors became available. Chemistry's next gift to the automotive finish industry was alkyd resins. These were used in the making of alkyd enamels. Alkyd resins were derived from glycerin processed from animal and vegetable fats. This glycerin was primarily used in explosives and in solvents such as those used in paint.

The alkyd enamels of the 1930s represented the early stages of what could be recognized as the modern process of automotive finishing. These enamels offered an excellent gloss finish and a reasonable color palette. As with previous advances in coatings, alkyd enamels were more durable, and of course, faster. When domestic development resumed after World War II, acrylic lacquers gave the OEM and refinish industries a quantum leap forward. Lacquer offered an exceptionally fast drying time compared to the early enamels. This translated into a significant

productivity increase on assembly lines which facilitated automobile manufacturing to meet the high post-war demand. The acrylic lacquer formulation also brought an

even greater expanse to available color formulations. Nitrocellulose lacquers were used on some passenger cars until about 1957, when solution acrylic lacquers were introduced. Acrylic lacquers offered much improved durability and a wider range of bright, pleasing colors – especially metallics.

Enamels outperformed the lacquers by eliminating the buffing required after drying to achieve a high-gloss finish and also provided an improved resistance to UV damage. They also benefited users by both retaining durability and outpacing the speed of the earlier application methods. The use of catalysts, which began shortly after the introduction of acrylic enamels, boosted performance up to 50 percent over lacquers to provide further improvements in appearance and durability, a new type of finish, called "Basecoat/Clearcoat," was developed and introduced in the late 70's. The topcoat paint system was split into a pigmented enamel basecoat, followed by a clear enamel finish. The key to this technology was the development of a clearcoat material with superior durability in all climates. Initially, the cost of the basecoat/clearcoat paint system was prohibitive and it was only used on some high-end automobile finishes. However, refinements in the material technology and processing helped to reduce costs, and by the late 80's this paint system had become widespread. In fact, only a small percentage of cars manufactured today do not use this basecoat/clearcoat paint system.

The benefits of this two-layer system were many. It increased the gloss of paint considerably, which was unsurpassed by any other paint system. It also allowed the paint formulators to incorporate UV absorbers to protect the clearcoat and the pigments in the basecoat from oxidation. Therefore, it could take years to show any dulling effect.

2.2 INTRODUCTIONS

The painting processes start after the body of vehicle is assembles. The purpose of this processes are to give more attractive appearance to the vehicles and to provide the layer of protection against corrosion and weathering. The paints and coatings industry is made up of many different types of operations, ranging from large-volume original equipment manufacturers (OEMs) that run highly automated, closely monitored systems to custom shops performing a range of contract work with manually operated equipment [1]. There are five major processes in painting processes; pre-treatment and electrodeposition (ED), ED sanding, sealant and PVC line, primer, and top coat. (See Figure 2.1)

In addition to being responsible for the colors and attractiveness of a vehicle, automotive paints provide protection against corrosion and weathering. Conventional paint films are only as thick as a human hair, but consist of four layers. In a conventional process, an automotive chassis is prepared, dipped in an electrocoat and then has a primer applied to it to provide corrosion protection. For adhesion, these layers are baked onto the chassis in an oven. Then the basecoat, which provides the actual color, and clearcoat for appearance and scratch resistance are applied. The chassis is again baked in an oven to complete the painting process.

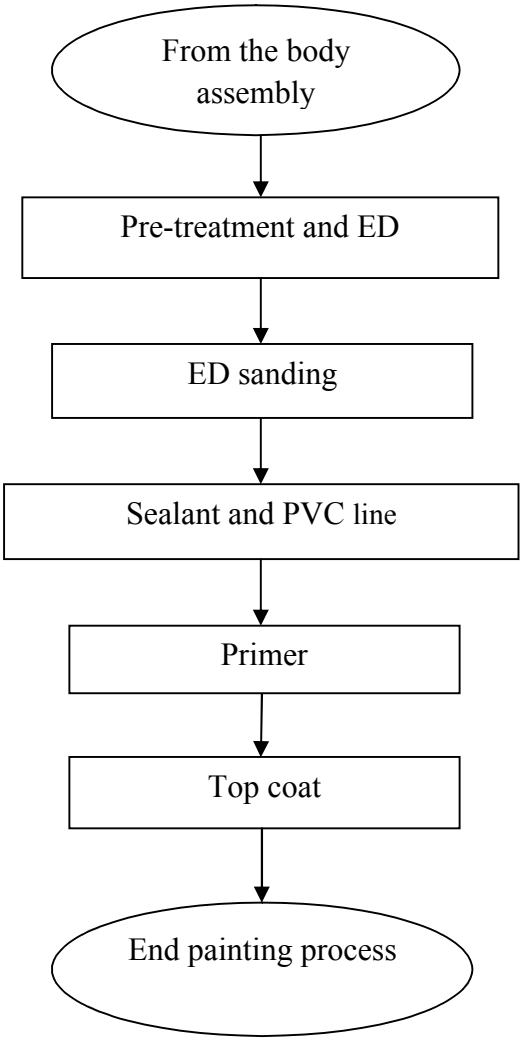

Figure 2.1: Painting Processes

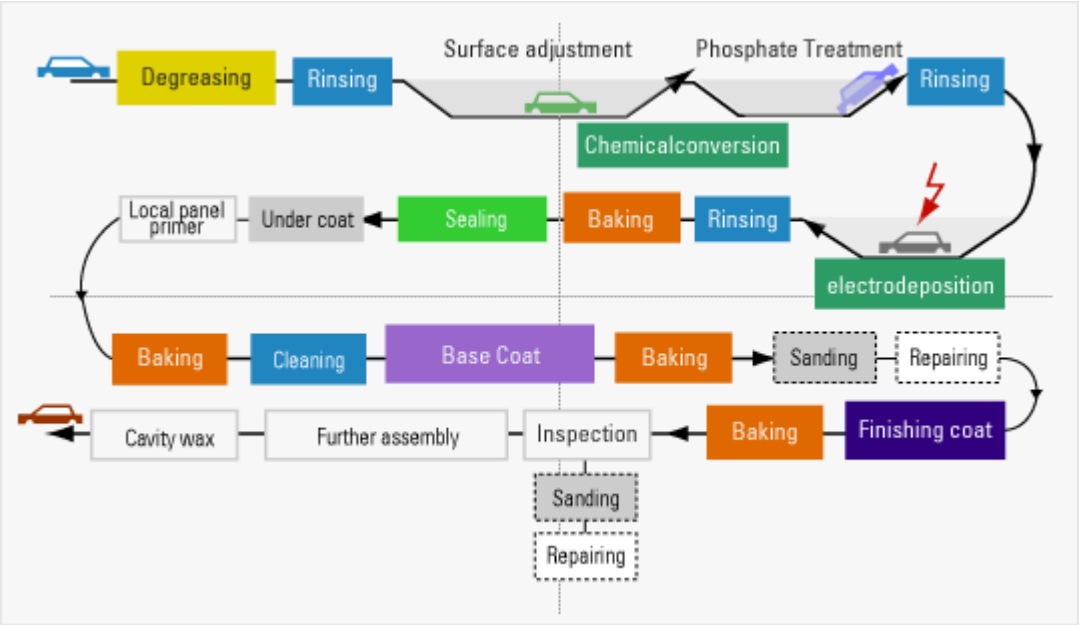

Figure 2.2 Overview Painting Process

2.3 PAINTING PROCESS

2.3.1 Pre-treatment and ED

The vehicle bodies, which are generally made of light-weight steel, undergo surface preparation and pre-treatment. This preparation involves through washing and wipe-cleaning. The pre-treatment process causes a chemical crystalization to occur on the vehicle surface that provides improved paint adhesion and anti-corrosion protection.

The purposes of pre-treatment are to remove foreign materials, for examples oil, dust etc, and also to form a layer of zinc phosphate crystal on the surface of body of vehicles. Before the pre-treatment process, the cleaning the body of vehicles is